Reduced Use of Pesticides in Tick Control in the Urban Environment

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Abstract
Urban environment usually consists of wide range of heterogeneous ecosystems with diverse and complex interactions. All green areas, especially parks and lawns, represent suitable habitats for ticks, as they provide all necessary features to complete a ticks' life cycle. Vegetation cover and the presence of suitable hosts are crucial for tick population persistence. Therefore, vegetation management as a preventive method should have the fundamental role in tick control. The aim of this research was to determine whether regular and frequent mowing and vegetation management have influence on the efficacy of tick control program. The tick presence and abundance were observed at seven localities, from February till October during 2014. The total number of collected ticks was 1.241 and two tick species were identified: *Ixodes ricinus* and *Dermacentor marginatus*. Ticks were present at all prospected localities except Dunavski Park. The highest number of collected ticks was obtained at Park of Poplar Research Institute and the lowest at Kamenica Park. In order to obtain one integrated, but adequate, environmental safe and less expensive method for tick control, it is necessary to integrate constant monitoring of tick populations, mowing as a preventive method and control of potential tick hosts.

Introduction
Urban environment usually consists of wide range of heterogeneous ecosystems with diverse and complex interactions. Almost all areas in the cities are managed and manipulated by man [1]. All green areas, especially parks and lawns, represent suitable habitats for ticks, as they provide all necessary features to complete a tick life cycle. Vegetation cover and the presence of suitable hosts for adult ticks are crucial for tick population persistence [2]. The successful survival of ticks in certain habitats depends on optimal temperature and humidity. Exophilic ticks which live in the lower parts of vegetation, litter and upper layer of the soil are especially dependent on these microclimate features [3]. Furthermore, even one species of medium-sized hosts (hare, hedgehog) could support the tick population, but the size of the locality, the type of adjacent territories, the scale of anthropogenic influence and the degree of its isolation from other potential tick localities are also important [3]. Different human activities could change microclimatic conditions that influence ticks' development and their hosts [4].
Ticks have always been a part of urban fauna. The urbanization and human activities connected with it may often positively influence the occurrence and abundance of ticks, both in short- and in long-term perspectives [5].
Urban forest parks are different in their size and position in the city. Some of them are in the central areas so they have rather weak or no connection at all with natural forests. They are exposed to the strong anthropogenic influence and the abundance of all tick stages in such localities is usually very low. Oppositely, parks placed at the edges of the cities, in the semi-urban areas, have good connection with surrounding forests or agroecosystems. Although the

anthropogenic influence could be high at these localities, the number of potential hosts is higher.

Worldwide, researchers are making a great effort to develop the most efficient method for tick control, especially in urban areas. The application of insectoacaricides based on synthetic pyrethroids today is the most frequent. However, the excessive use of these pesticides in tick control could be dangerous for human and animal health and cause environmental pollution. Certain tick species are sensitive to desiccation and usually search for sufficient humidity in microhabitats at ground levels or sheltered by vegetation cover. During unfavorable microclimatic conditions a great number of different tick stages dies, considerable number finds shelters at surface ground layer, and certain number even permanently leaves the habitat [4]. Therefore, vegetation management as a preventive method should have the crucial role in tick control.

The aim of this research was to determine whether regular and frequent mowing and vegetation management have influence on the efficacy of tick control program.

Experimental

Tick sampling and identification

The tick presence and abundance were observed at seven localities, from February till October during 2014. Ticks were sampled according to "Flag-hour" method [6]. White flannel cloth (1x1.6 m) was dragged through the low vegetation and soil surface for an hour, through the chosen transect in total length of 100 m. Five transects were chosen for each locality. Both sides of the cloth were carefully examined every 20 m, and all ticks were collected. Ticks were placed in the plastic tubes with a small cotton ball soaked into water to prevent desiccation and closed with perforated plastic stopper for sufficient ventilation. Ticks were sampled monthly, from 10 am till 6 pm, if the weather conditions were suitable.

Ticks were identified according to identification keys [7]. All tick stages (larvae, nymphs and adults) were identified and counted.

Localities

The study was performed at seven localities in Novi Sad (Province of Vojvodina, Serbia), based on tick abundance, floristic composition and everyday human activities. Five of them were in urban areas of the city with high anthropogenic influence: Railway Station Park (9 ha, N45°15'841, E19°49'403), Omladinski Park (3 ha, N45°15'443, E19°51'219), Dunavski Park (4 ha, N45°15'198, E19°51'053), Limanski Park (10 ha, N45°14'201, E19°50'347), Futoški Park (5 ha, N45°15'020, E19°49'376). The sixth locality, Kamenica Park (18 ha, N45°13'663, E19°50'776) was in semi-rural area, near the city, known for picnic places, trim, jogging and cycling pathways. The seventh locality, The Park of Poplar Research Institute (50 ha, N45°17'586, E19°53'754), has never been under any chemical control program, and therefore was set as a control locality.

All prospected localities are park-forest type habitats, a combination of meadow vegetation and deciduous trees. The plant species were identified according to standard identification keys [8, 9 and 10]. The dominant tree species were: poplars (*Populus sp.*), sweet chestnut (*Castanea sativa*), silver birch (*Betula pendula*), oaks (*Quercus sp.*), white willows (*Salix alba*), plane trees (*Platanus sp.*), silver lime (*Tilia tomentosa*), maples (*Acer sp.*), field maple (*Acer campestre*), hornbeam (*Carpinus betulus*). The shrub vegetation was consisted of: forsythia (*Forsythia sp.*), dog-rose (*Rosa canina*), wild privet (*Ligustrum vulgare*) and hazel (*Corylus avellana*). The species of Poaceae family were dominant at all prospected localities: wall barley (*Hordeum murinum*), yellow foxtail (*Setaria glauca*) and meadow grasses (*Poa sp.*), but also: dandelion (*Taraxacum officinale*), Shepherd's-purse (*Capsella bursa pastoris*), greater plantain (*Plantago major*), fat-hen (*Chenopodium album*), amaranth (*Amaranthus*

retroflexus), cleavers (*Galium aparine*) and red clover (*Trifolium pratense*).

Results and discussion

The total number of collected ticks was 1.241 and two tick species were identified: *Ixodes ricinus* Linnaeus 1758 and *Dermacentor marginatus* Sulzer 1776. Ticks were present at all prospected localities except Dunavski Park. The highest number of collected ticks was obtained at Park of Poplar Research Institute and the lowest at Kamenica Park (Tab. 1.). Larval stages were collected only at Park of Poplar Research Institute. This locality has never been treated with any insectoacaricides. The tick populations here are persistent and independent, so they could be marked as self-sufficient populations which can persist and flourish without replenishment [3].

Table 1. The number of collected ticks in parks in Novi Sad

	February	March	April	May	June	July	August	September	October	Total number
Park of Poplar Research Institute	6	11	21	57	493	321	62	65	52	1080
Kamenica Park	0	2	1	0	0	0	0	1	1	5
Railway Station Park	0	1	2	9	5	3	1	3	2	26
Omladinski Park	3	5	9	24	18	9	5	9	7	89
Dunavski Park	0	0	0	0	0	0	0	0	0	0
Limanski Park	0	0	1	3	2	0	0	1	0	7
Futoški Park	0	3	4	8	8	5	2	2	2	34

Kamenica Park, Dunavski Park and Limanski Park were properly maintained throughout the year: regularly and frequently mowed, the litter was regularly collected and the chemical treatments were applied two to three times during the season (April, May/June, September). Because of high anthropogenic presence at these localities, the number of potential host species was low (lizards, birds, cats and dogs). On the contrary, Railway Station Park, Omladinski Park and Futoški Park were mowed only once or twice during the year and the litter were not regularly collected. Although the chemical treatments were applied too, these localities had relatively high densities of tick populations. The highest abundance of ticks was noticed in shrub belt on the edge of these parks. Additionally, at these localities more potential host species were present: lizards, birds, rats, mice, hedgehogs, squirrels, cats, dogs and sometimes hares.

Tick populations noticed in Kamenica Park, Dunavski Park and Limanski Park could be described as dependent or temporary, as these populations cannot persist without constant replenishment or they are short-lived populations in unfavorable habitats which are periodically appearing after tick specimens importation by their hosts from the outside. Railway Station Park, Omladinski Park and Futoški Park have semi-independent population of ticks that could not be maintained without replenishment [3].

The constant presence of *I. ricinus* and *D. marginatus* in Railway Station Park, Omladinski Park and Futoški Park could be explained by ticks' specific microclimatic requirements such as temperature and constant humidity which was obtained by unmowed vegetation cover. The ideal habitat for *I. ricinus* in continental Europe is a deciduous forest with damp soil covered with rich undergrowth [11]. Although treatments were applied at these localities too, the

persistent ticks' populations could be explained by unregularly mowing which provided certain degree of humidity and higher number of different host species.

Conclusion

The modern urban areas represent perfect habitat for ticks, as they could complete their developmental cycles feeding on different but always present hosts. Proper vegetation covering and constant presence of adult tick hosts support persistence of the tick population. In order to obtain one integrated, but adequate, environmental safe and less expensive method for tick control, it is necessary to integrate constant monitoring of tick populations, mowing as a preventive method and the control of potential tick hosts. In that way the use of pesticides will be reduced in the urban areas and the program would be economically justified and environmental safe.

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References

[1] P. Bolund, S. Hunhammar. Ecological Economics. 29 (1999) 293.
[2] I. Uspensky. Proceedings of the Conference GERI 2015 (Genes, Ecosystems and Risk of Infection), Creete, Greece, 21-23 April, 2015.
[3] I. Uspensky. Proceedings of the 8th International Conference on Urban Pests, Zurich, Switzerland, 20 – 23 July, 2014, 203.
[4] A. Jurisic, A. Petrovic, D. Rajkovic, S. Nicin. Exp. Appl. Acarol. 52 (2010) 101
[5] I. Uspensky. Ticks and Tick-borne Diseases 5 (2014) 41.
[6] G.O. Maupin, D. Fish, J. Zultowsky, E.G. Campos, J. Piesman. Am. J. Epidemiol. 133(11) (1991) 1105.
[7] A.Estrada-Penňa, A. Bouattour, J.Camicas, A. Walker. Ticks of domestic animals in the Mediterranean Region. A guide to identification of species. University of Zagaroza, Spain. 2004.
[8] M. Josifović, (ed.). Flora SR Srbije, I-IX, SANU, Beograd, Srbija, 1970-1977.
[9] M. Sarić, (ed.): Flora Srbije X, SANU, Beograd, Srbija, 1986.
[10] F. Rose: The Wild Flower Key. Penguin Books Ltd, England, 1981
[11] L. Gern, E. Rouvinez, L.N. Toutoungi, E. Godfroid. Folia Parasitologica. 44 (1997) 309.